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BOX: PATENT APPLICATION

Assistant Commissioner for Patents
Washington, D.C. 20231

July 28, 2000

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Re: Application of Jong-Chul CHOI
DEVICE FOR ENHANCING CONTRAST IN LIQUID CRYSTAL DISPLAY PROJECTION SYSTEM
Our Reference: Q60267

Dear Sir:

Attached hereto is the application identified above including the specification, claims, executed Declaration and Power of Attorney, two (2) sheets of drawings, one (1) priority document, executed Assignment and PTO Form 1595.

The Government filing fee is calculated as follows:

Total Claims	8 - 20 =	0 x \$18 =	\$ 000.00
Independent Claims	1 - 3 =	0 x \$78 =	\$ 000.00
Base Filing Fee	(\$690.00)		\$ 690.00
Multiple Dep. Claim Fee	(\$260.00)		\$ 000.00
TOTAL FILING FEE			\$ 690.00
Recordation of Assignment Fee			\$ 40.00
TOTAL U.S. GOVERNMENT FEE			\$ 730.00

Checks for the statutory filing fee of \$ 690.00 and Assignment recordation fee of \$ 40.00 are attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 19-4880. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. 1.16 and 1.17 and any petitions for extension of time under 37 C.F.R. 1.136 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

Priority is claimed from:

Korean Patent Application

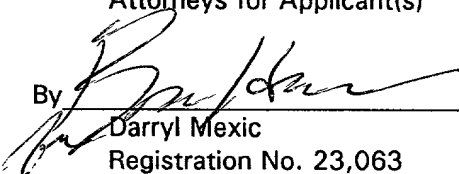
99-30995

Filing Date

July 29, 1999

Respectfully submitted,
SUGHRUE, MION, ZINN, MACPEAK & SEAS
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DEVICE FOR ENHANCING CONTRAST IN LIQUID CRYSTAL DISPLAY PROJECTION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a liquid crystal display (LCD) projection system, and more particularly, to a device for enhancing contrast of an image which is projected on a screen according to a result of comparing an average level of an image signal and a reference level.

2. Description of the Related Art

In general, a projection system adopting a liquid crystal display (LCD) scans an image signal which is supplied from an image driver and displayed on a LCD panel with light incident from an illumination optical system. Here, the scanned light is projected on the screen through a deflection plate and a projection lens, to thereby regenerate an enlarged image.

A conventional LCD projection system will be described with reference to FIG. 1.

The LCD projection system of FIG. 1 includes illumination optical system 10 through 14, an image driver 16, a LCD panel 15 and a projection optical system 17 through 19.

The illumination optical system includes an optical unit 10 for emitting and reflecting light, and a relay lens 11 for making an optical feature of the light emitted from the optical unit 10 and reducing an

angle of divergence, by use of a total reflection feature. Also, the illumination optical system includes a collimating lens 12 for converting the light passed through the relay lens 11 into parallel light, a dichroic mirror 13 for separating the parallel light into three primary color signal components R, G and B and altering a light path, and a first polarizing plate 14 for polarizing each color signal component supplied from the dichroic mirror 13 to be incident to the LCD panel 15.

The image driver 16 performs a predetermined signal processing with respect to an image signal input from an image signal processor (not shown) to be displayed on the LCD panel 15, and converts the image signal into a driving control signal to be supplied to the LCD panel 15. Here, the image driver 16 further performs an ABL (auto brightness limiter) control function which is well known to a person skilled in the art. The ABL control function is to obtain an average level of an image signal to be displayed on the LCD panel 15, or an externally input image signal, so as to maintain the brightness of the image to be displayed on the LCD panel 15 consistently. Then, the average level is compared with a set reference level, and a gain of the image signal supplied to the LCD panel 15 is adjusted according to the comparison result. That is, if the obtained average level is higher than the reference level through the ABL control function, a low-level ABL control signal for decreasing the gain of the image signal supplied to the LCD panel 15 is applied to an amplifier (not shown). Meanwhile, if the former is lower than the latter, a high-level ABL control signal for increasing the gain of the image signal supplied to the LCD panel 15 is

applied to the amplifier. The above control operation is linearly performed.

The LCD panel 15 displays a corresponding image thereon according to the driving control signal of the image signal supplied from the image driver 16 and scans the image according to the intensity of the illuminated light incident from the illumination optical system.

A second polarizing plate 17 disposed between the LCD panel 15 and a focusing lens 18 selectively transmits or blocks the light scanned from the LCD panel 15, according to the polarizing component of the light. The focusing lens 18 focuses the light transmitted through the second polarizing plate 17 and transfers the focused light to a projection lens 19. The projection lens 19 projects the light transferred from the focusing lens 18 onto a screen (not shown), to thereby enlarge the image regenerated on the screen.

However, in the case of the conventional LCD projection system, the contrast of the LCD panel itself on which the image signal is primarily displayed is much lower than that of a display device such as a cathode ray tube (CRT), and the polarizing plate disposed between the LCD panel and the projection lens does not block the light completely although the degree of polarization is 99.5% or more. Thus, since the black level of the image having passed through the LCD panel and the polarizing plate and regenerated on the screen does not become a perfect black level, the conventional LCD projection system has a problem in which the contrast of the regenerated image is greatly lowered.

SUMMARY OF THE INVENTION

To solve the above problems, it is an object of the present invention to provide a device for remarkably enhancing contrast of an image regenerated in a projection system in which a liquid crystal display (LCD) is used as an image display device.

To accomplish the above object of the present invention, there is provided a device for enhancing contrast for a liquid crystal display (LCD) projection system, the contrast enhancing device comprising: an image driver supplying an image signal; a LCD panel for converting the input image signal into an optical image signal; and a contrast control portion positioned on the same optical axis as that of the LCD panel, for controlling an amount of scanned light according to the brightness of a corresponding image.

BRIEF DESCRIPTION OF THE DRAWINGS

The above object and other advantages of the present invention will become more apparent by describing the preferred embodiment thereof in more detail with reference to the accompanying drawings in which:

FIG. 1 shows a conventional LCD projection system; and

FIG. 2 shows a LCD projection system for explaining an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

A LCD projection system according to a preferred embodiment of

the present invention will be described in detail with reference to FIG. 2.

The LCD projection system of FIG. 2 includes illumination optical system 10 through 14, an image driver 16, a LCD panel 15 and a projection optical system 17 through 19, as basic elements. A contrast control portion 20 according to a technological concept of the present invention is functionally combined with the above elements.

The contrast control portion 20 includes a contrast controller 21 and a contrast control plate 22. The contrast control plate 22 is disposed between the LCD panel 15 and the second polarizing plate 17. The contrast control plate 22 is opened or closed according to the level of an applied contrast control signal, to thereby control an amount of light of an image scanned from the LCD panel 15, or a light intensity to be transferred to the second polarizing plate 17. It is preferable that the contrast control plate 22 is implemented as a liquid crystal display (LCD), and controls the degree of the opening and closing of cells constituting the LCD according to the level of the applied contrast control signal. Here, in the case that the contrast control signal is a high-level analog signal, the cell of the contrast control plate 22 is opened properly to transmit the light having passed through the LCD panel 15. Meanwhile, in the case that the contrast control signal is a low-level analog signal, the cell of the contrast control plate 22 is closed properly to block the light having passed through the LCD panel 15.

The contrast controller 21 applies the contrast control signal to the contrast control plate 22, in which the contrast control signal controls the

above-described optical cell to be closed in correspondence to a difference value if the average level of the image signal is lower than the reference level, or controls the above-described optical cell to be opened in correspondence to a difference value if the average level of the image signal is higher than the reference level. Here, it is preferable that the contrast controller 21 receives the above-described ABL control signal generated from the image driver 16 and applies a contrast control signal which is inversely proportional to the level of the ABL control signal, to the contrast control plate 22.

Thus, in the case that the applied ABL control signal is a high-level signal, the contrast controller 21 applies a low-level contrast control signal which is inversely proportional to the level of the ABL control signal to the contrast control plate 22. As a result, the cell of the contrast control plate 22 is controlled to be in the closed state by a value corresponding to the low-level contrast control signal. Thus, the light which has become bright in the total image on the LCD panel 15 is properly blocked by the ABL control signal, to thereby enhance the contrast greatly. Reversely, in the case that the applied ABL control signal is a low-level signal, the contrast controller 21 applies a high-level contrast control signal which is inversely proportional to the level of the ABL control signal to the contrast control plate 22. As a result, the cell of the contrast control plate 22 is controlled to be in the opened state by a value corresponding to the high-level contrast control signal. Thus, the light which has become dark in the total image on the LCD panel 15 is properly transmitted by the ABL control signal, to thereby maintain

the contrast.

In particular, the second polarizing plate 17 cannot block the light corresponding to the black level of the image alone, but the contrast control plate 22 is used together with the second polarizing plate 17 to play a role of perfectly blocking the light corresponding to the black level, to thereby remarkably enhance the contrast of the image.

The LCD projection system according to the present invention uses the contrast control plate which is controlled based on the result of comparing the average level of the image signal to be displayed with the reference level, to thereby prevent the lowering of the contrast of the image due to the characteristic of the LCD panel itself. In particular, the present invention employs the contrast control plate which is controlled based on the ABL control signal, to thereby further enhance the contrast as the brightness of the total image becomes higher.

What is claimed is:

1. A device for enhancing contrast for a liquid crystal display (LCD) projection system, the contrast enhancing device comprising:

an image driver supplying an image signal;

a LCD panel for converting the input image signal into an optical image signal; and

a contrast control portion positioned on the same optical axis as that of the LCD panel, for controlling an amount of scanned light according to the brightness of a corresponding image.

2. The contrast enhancing device of claim 1, wherein said image driver includes an auto brightness limiter (ABL) function for automatically controlling an average brightness of the image signal supplied on said LCD panel.

3. The contrast enhancing device of claim 2, wherein said contrast control portion comprises:

a contrast control plate for controlling an amount of light scanned from said LCD panel; and

a contrast controller for generating a contrast control signal for controlling the degree of the opening and closing said contrast control plate according to the ABL control signal.

4. The contrast enhancing device of claim 3, wherein said contrast controller applies the contrast control signal which is inversely

proportional to the ABL control signal supplied from said image driver.

5. The contrast enhancing device of claim 2, wherein said contrast control plate is a LCD.

6. The contrast enhancing device of claim 5, wherein said contrast control plate controls the degree of the opening and closing cells constituting the LCD according to the contrast control signal applied from said contrast controller.

7. The contrast enhancing device of claim 2, wherein said contrast controller applies the contrast control signal for controlling said contrast control plate to be closed in correspondence to a difference value if the average level of the image signal is lower than the reference level, or controlling said contrast control plate to be opened in correspondence to a difference value if the average level of the image signal is higher than the reference level.

8. The contrast enhancing device of claim 1, further comprising a polarizing plate for selectively transmitting the light scanned from said LCD panel according to the polarization component of the light, wherein said contrast control portion is disposed on an optical path between said LCD panel and said polarizing plate.

ABSTRACT OF THE DISCLOSURE

A device for enhancing contrast for a liquid crystal display (LCD) projection system is provided. The contrast enhancing device includes an image driver supplying an image signal, a LCD panel for converting the input image signal into an optical image signal, and a contrast control portion positioned on the same optical axis as that of the LCD panel, for controlling an amount of scanned light according to the brightness of a corresponding image. Accordingly, the projection system adopting an image display device as a liquid crystal device provides a remarkably enhanced contrast enhancement effect. In particular, as the brightness of the total image is brighter, the contrast enhancement effect becomes larger.

FIG. 1 (PRIOR ART)

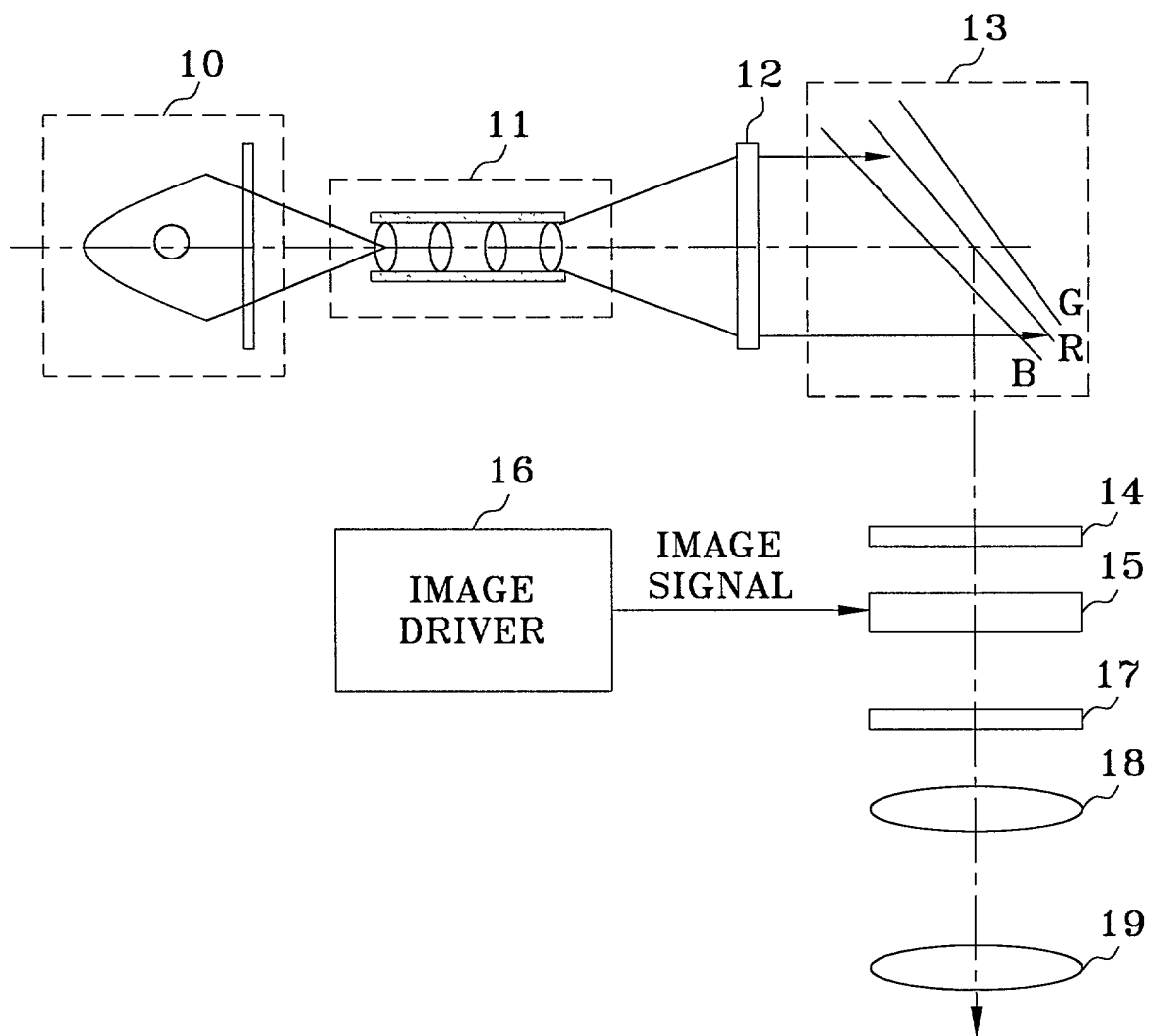
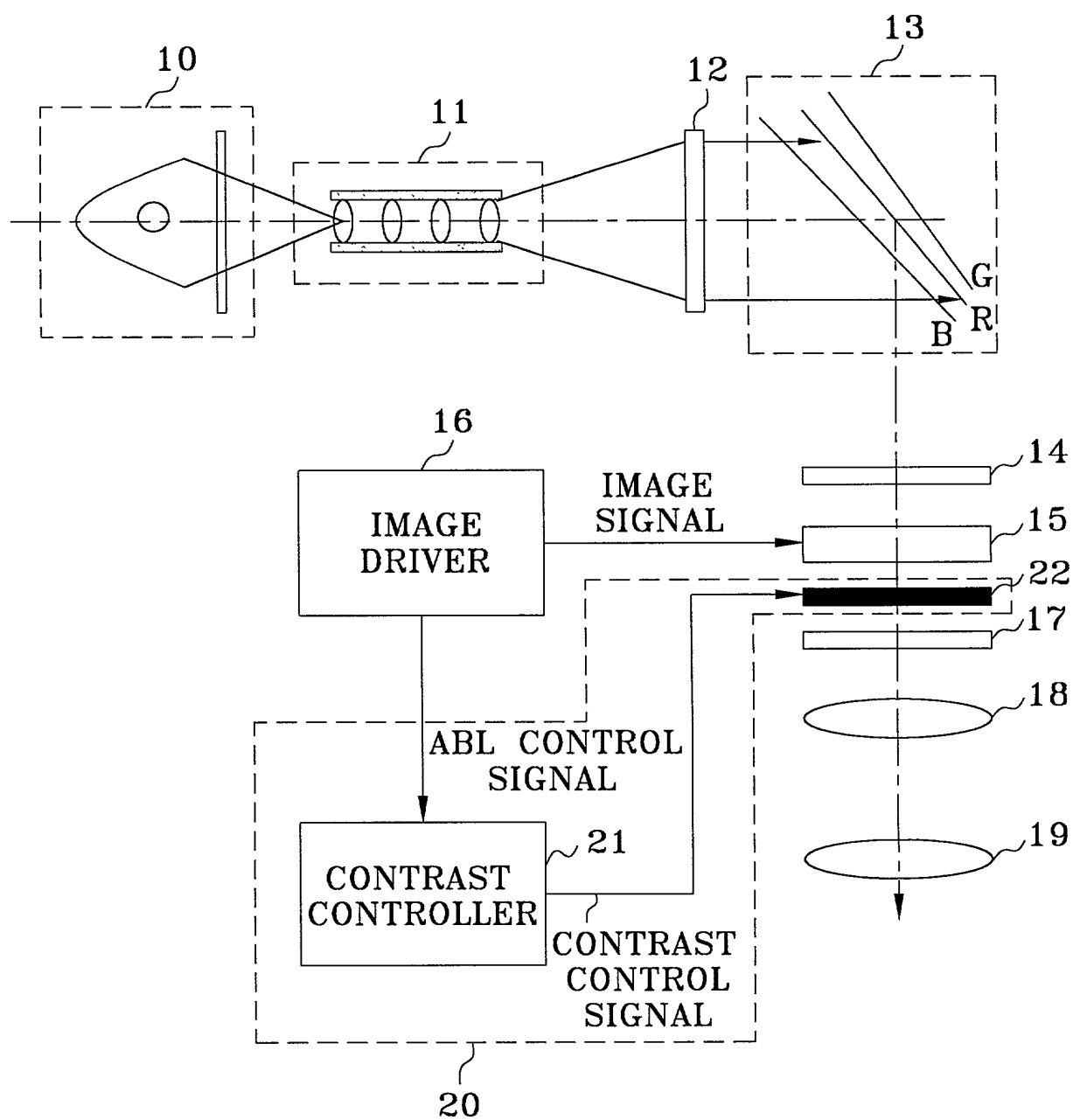


FIG. 2



Declaration and Power of Attorney For Patent Application

출원서원본상의 선서서와 위임장

Korean Language Declaration

한국어 선서서

하기한 발명자인 본인은 다음과 같이 선서합니다:

본인의 주소, 우편주소 및 국적은 본인의 이름 밑에 기재된 바와 같습니다.

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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

DEVICE FOR ENHANCING CONTRAST

IN LIQUID CRYSTAL DISPLAY

PROJECTION SYSTEM

아래 박스에 표시가 되어있지 않는 한
특허설명서는 여기에 첨부되어 있음:

☐ __월 __일 미국출원번호 또는 PCT국제출원번호
__월 __일 수정되었습니다.
(만약 적용가능하면)

the specification of which is attached hereto unless the following box is checked:

☐ was filed on _____
as United States Application Number or
PCT International Application Number
_____ and was amended on
_____ (if Applicable).

본인은 상기 수정출원을 포함하여 특허설명서 내용을 검토하였으며 잘 파악하고 있음을 선서합니다.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

본인은 연방규정법전 37장 1.56편에 따라 특허자격에 있어 중요한 정보자료를 밝히는 것이 본인의 의무임을 인정합니다

I acknowledge the duty to disclose information which is material to patentability as defined in the Title 37, Code of Federal Regulations, Section 1.56.

Korean Language Declaration

한국어 선언서

본인은 미합중국법전 35장 119(a)-(d)편 또는 특허 또는 발명자 증서를 위한 그 어떤 외국출원의 365(b)편 또는 미국 이외에 최소한 국가를 지정하는 PCT국제출원의 365(a)편하의 외국우선권을 주장합니다. 아래 박스에 표시함으로써 기재하고 확인합니다.

Prior Foreign Application(s)

이전의 외국 출원

99-30995 Korea
Number (번호) (Country) (국명)

Number (번호) (Country) (국명)

Number (번호) (Country) (국명)

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed
우선권 주장안함

29/07/99
Day/Month/Year Filed (출원년월일) ☐

(Day/Month/Year Filed) (출원년월일) ☐

(Day/Month/Year Filed) (출원년월일) ☐

본인은 미합중국법전 35장, 아래에 기재한 그 어떤 미국출원의 119(e)편하의 권한을 주장합니다.

Application No. (출원번호) (Filing Date) (출원일)

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

Application No. (출원번호) (Filing Date) (출원일)

본인은 미합중국법전 35장, 그 어떤 미국출원의 120 편 또는 미국을 지정하는 그 어떤 PCT국제출원의 365(c)편하의 권한을 주장합니다. 미합중국법전 35장 112편의 첫단락에 제시된 방법에 따라 이전의 미국 또는 PCT국제출원에 이제까지 기재된 본출원 내용은 밝혀지지 않았습니다. 본인은 연방규정법전 37장 1.56편에 따라 이전출원의 출원일과 국내 또는 PCT국제출원의 출원일사이에 유효된 특허자격에 있어 중요한 정보자료를 밝히는 것이 본인의 의무임을 인정합니다.

Application No. (출원번호) (Filing Date) (출원일)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Status: Patented, Pending, Abandoned) (현황: 특허완료, 심사중, 포기됨)

Application No. (출원번호) (Filing Date) (출원일)

(Status: Patented, Pending, Abandoned) (현황: 특허완료, 심사중, 포기됨)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Korean Language Declaration

한국어 선서서

위임장: 본인은 본건출원과 관련된 모든 사무를 처리하기 위하여 대리인을 지명합니다. 상기 각자는 대리인으로서 최소 및 업무제휴가 ~~필요한~~ 대리인을 지명할 전권을 갖습니다. (성명 및 등록번호 기재)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)

I hereby appoint John H. Mion, Reg. No. 18,879; Donald E. Zinn, Reg. No. 19,046; Thomas J. Macpeak, Reg. No. 19,292; Robert J. Seas, Jr., Reg. No. 21,092; Darryl Mexic, Reg. No. 23,063; Robert V. Sloan, Reg. No. 22,775; Peter D. Olexy, Reg. No. 24,513; J. Frank Osha, Reg. No. 24,625; Waddell A. Biggart, Reg. No. 24,861; Robert G. McMorrow, Reg. No. 19,093; Louis Gubinsky, Reg. No. 24,835; Neil B. Siegel, Reg. No. 25,200; David J. Cushing, Reg. No. 28,703; John R. Inge, Reg. No. 26,916; Joseph J. Ruch, Jr., Reg. No. 26,577; Sheldon I. Landsman, Reg. No. 25,430; Richard C. Turner, Reg. No. 29,710; Howard L. Bernstein, Reg. No. 25,665; Alan J. Kasper, Reg. No. 25,426; Kenneth J. Burchfiel, Reg. No. 31,333; Gordon Kit, Reg. No. 30,764; Susan J. Mack, Reg. No. 30,951; Frank L. Bernstein, Reg. No. 31,484; Mark Boland, Reg. No. 32,197; William H. Mandir, Reg. No. 32,156; Scott M. Daniels, Reg. No. 32,562; Brian W. Hannon, Reg. No. 32,778; Abraham J. Rosner, Reg. No. 33,276; Bruce E. Kramer, Reg. No. 33,725; Paul F. Neils, Reg. No. 33,102; and Brett S. Sylvester, Reg. No. 32,765, my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and request that all correspondence about the application be addressed to SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC, 2100 Pennsylvania Avenue, N.W., Washington, D.C. 20037-3202.

서신을 위한 주소:

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직통전화번호: (성명 및 전화번호)

Direct Telephone Calls to: (name and phone number)

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국적	Citizenship	Korean
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Kyungki-do, Republic of Korea		
두번째 합동 발명자 성명(만약 있으면:)	Full name of second joint inventor, if any	
두번째 발명자의 서명	Second inventor's signature	Date
거주지	Residence	
국적	Citizenship	
우편주소	Post Office Address	

(세번째와 그의 합동발명자의 위와 비슷한 기재사항과 서명을 제공하십시오.)

(Supply similar information and signature for third and subsequent joint inventors.)